SWORN TRANSLATION

I, Hiromitsu Hara, hereby declare and state that I am knowledgeable of each of the English and Japanese languages and that I made the attached translation of the certified copy of Japanese Patent Application No. 2000-4348 from the Japanese language into English language and that I believe my attached translation to be accurate, true and correct to the best of my knowledge and ability.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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Hiromitsu Hara

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[Inventor]	
[Address]	3-6, Ogawahigashi-Cho 3-Chome, Kodaira City, Tokyo, Japan
[Name]	Takaya YAMANAKA
[Applicant]	
[Identification Number]	000005278
[Name]	BRIDGESTONE CORPORATION
[Representative]	
[Identification Number]	100059258
[Patent Attorney]	
[Name]	Akihide SUGIMURA
[Representative]	
[Identification Number]	100072051
[Patent Attorney]	
[Name]	Kosaku SUGIMURA
[Representative]	
[Identification Number]	100098383
[Patent Attorney]	
[Name]	Junko SUGIMURA
[Identification of Fee]	
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[Identification of Document] Specification

[Title of the Invention] Pneumatic tire

[Claims]

[Claim 1] A pneumatic tire comprising a tread portion, a pair of sidewall portions and a pair of bead portions and one radial carcass reinforcing these portions between a pair of bead cores embedded in the respective bead portions and one or more rubberized steel cord reinforcing layers reinforcing the bead portion, characterized in that

the radial carcass has a wind contact part wound around the bead core from an inside of the tire through outside to an outer periphery of the bead core, and the wind contact part has a terminal end at a position of the outer periphery of the bead core;

the bead portion reinforcing layer has many steel cords of only a strand structure, and the steel cord has a cord diameter within a range of 1.00-1.50 mm;

an end of the steel cord in a terminal end portion of the bead portion reinforcing layer has a flare, and the flare has a scattering width within a range of 1.0-1.5 times the cord diameter;

the steel cords in the bead portion reinforcing layer are arranged at a distance between the cords of 1.00-1.50 mm in a direction perpendicular to a longitudinal axis of the cord.

[Claim 2] A pneumatic tire according to claim 1, wherein the steel cord of the bead portion reinforcing layer is a Z-lay outer-sheath structure.

[Detailed Explanation of the Invention]

[0001]

[Field of the Invention]

This invention relates to a pneumatic tire, and more particularly to a heavy duty pneumatic radial tire for use in truck, bus and the like, and particularly to a pneumatic tire having an improved bead portion durability.

[0002]

[Prior Art]

As shown in Fig. 3, the conventional pneumatic tire 11 used for the heavy duty vehicle as previously mentioned is run under a heavy load, so that it is apt to easily cause troubles in a bead portion 14 directly supporting the heavy load together with a rim. Particularly, since a large strain concentrates in an end 16te of

a turnup portion 16t of a radial carcass 16, there is a typical example that a trouble nucleus such as cracks or the like is generated in the turnup end 16te and this crack grows to cause a separation failure in the turnup portion 16t.

[0003]

In order to improve the separation failure of the turnup portion 16t, it is usual to arrange a bead portion reinforcing layer 18 along the outside of the turnup portion 16t so as to extend over the turnup end 16te. This bead portion reinforcing layer 18 is a rubberized steel cord layer generally called as a wire chafer. The reinforcing layer 18 of this type is a layer containing steel cords arranged obliquely in the radial direction different from the fact that the cords in the turnup portion 16t of the radial carcass 16 extend substantially in the radial direction of the tire 11. As a result, strain applied to an upper end 18e of the steel cord in the reinforcing layer 18 becomes smaller than the strain applied to the cord end in the turnup portion 16t, and hence it has a merit to hardly form a trouble nucleus such as crack or the like.

[0004]

However, as the tendency of flattening the tire becomes recently higher, input to the bead portion 14 is more severer, and hence the control of separation failure from the turnup end 16te is insufficient even in the reinforcement of the bead portion 14 with the wire chafer 18. Therefore, there is proposed a new structure that a full terminal part of the turnup portion 16t is located on an outer periphery of the bead core form a wind contact part to the bead core rather than the turnup portion. Referring to Fig. 1, this new structure is a wind contact part 6W from a main portion 6b of the radial carcass 6.

[0005]

[Problem to be solved by the invention]

By adopting the new structure of the wind contact part 6w of the radial carcass 6 is largely mitigated strain at an end 6we of the radial carcass 6, and there is caused no separation failure at the end 6we. On the other hand, the trouble nucleus such as crack or the like is transferred to an end 18e of the wire chafer indispensable as the reinforcement of the bead portion shown in Fig. 3 by an increment that the bead portion durability is improved, and hence the problem on the bead portion durability is migrated to the separation failure in the wire chafer end 18e.

[0006]

However, there is no example of causing the troubles such as separation and the like at the wire chafer end 18e up to the present, so that means for improving the troubles can not be found out. At the present time, therefore, it is rapidly demanded to solve the occurrence of crack in the wire chafer end 18e and the separation failure accompanied with the growth thereof.

[0007]

Therefore, the inventions described in claims 1 and 2 fundamentally solve the aforementioned problem of the bead portion durability. That is, it is an object of the invention to provide a pneumatic tire in which the durability of the bead portion as a whole can be largely improved by largely improving a crack resistance at an end of a rubberized steel cord layer (wire chafer) as a bead portion reinforcing layer in addition to the improvement of the durability at the end portion of the radial carcass to improve the separation resistance of the bead portion.

[0008]

[Means for solving problem]

In order to achieve the above object, the invention described in claim 1 is a pneumatic tire comprising a tread portion, a pair of sidewall portions and a pair of bead portions and one radial carcass reinforcing these portions between a pair of bead cores embedded in the respective bead portions and one or more rubberized steel cord reinforcing layers reinforcing the bead portion, characterized in that

the radial carcass has a wind contact part wound around the bead core from an inside of the tire through outside to an outer periphery of the bead core, and the wind contact part has a terminal end at a position of the outer periphery of the bead core;

the bead portion reinforcing layer has many steel cords of only a strand structure, and the steel cord has a cord diameter within a range of 1.00-1.50 mm;

an end of the steel cord in a terminal end portion of the bead portion reinforcing layer has a flare, and the flare has a scattering width within a range of 1.0-1.5 times the cord diameter;

the steel cords in the bead portion reinforcing layer are arranged at a distance between the cords of 1.00-1.50 mm in a direction perpendicular to a longitudinal axis of the cord.

[0009]

The terms and test method on the above steel cord are according to contents described in "Test method of steel tire cord" of JIS G3510 (1992), and so forth. However, the width of the flare is a component of a longitudinally scattering length perpendicular to a cord axis.

[0010]

As to the invention described in claim 1, the steel cord of the bead portion reinforcing layer is a Z-lay outer-sheath structure as in the invention described in claim 2.

[0011]

[Embodiments of the Invention]

An embodiment of the invention will be described with reference to Figs. 1 and 2.

Fig. 1 is a diagrammatically left-half section view of an embodiment of the pneumatic tire according to the invention;

Fig. 2 is a schematically partial side view of a steel cord reinforcing layer perspectively drawn from a direction of arrow X in Fig. 1.

[0012]

In Fig. 1, a pneumatic tire (hereinafter referred to as tire) 1 comprises a tread portion 2, and a pair of sidewall portions 3 (only one side is shown) and a pair of bead portions 4 (only one side is shown) connecting to both sides thereof. Also, the tire 1 comprises a radial carcass 6 comprised of one ply extending between a pair of bead cores 5 embedded in the respective bead portions 4. The radial carcass 6 is comprised of the rubberized steel cord ply and reinforces the above portions 2 to 4. Furthermore, the tire 1 comprises a belt 7 arranged on an outer periphery of the radial carcass 6 for reinforcing the tread portion 2 and one or more reinforcing layers reinforcing the bead portion 4, one reinforcing layer 8 in the illustrated embodiment.

[0013]

The reinforcing layer 8 for the bead portion 4 is comprised of a rubberized steel cord layer. Also, the reinforcing layer 8 is arranged at least outside of the tire 1, and in the illustrated embodiment, it is arranged so as to extend to an inside of a main body 6b of the radial carcass 6. Moreover, numeral 9 in Fig. 1 is a stiffener rubber, and symbol E is an equatorial plane of the tire 1.

[0014]

In this case, the radial carcass 6 is wound around the bead core 5 from an inside of the tire 1 toward an outside thereof to form a wind contact part 6w along an outer peripheral face of the bead core 15. The wind contact part 6w has a terminal end 6we in the vicinity of the main body 6b of the radial carcass 6 at an outer peripheral position of the bead core 5.

[0015]

Referring to Fig. 2, the bead portion reinforcing layer 8 has many steel cords 8C each having only a strand structure without using a helically wrapped filament on the cords 8C. Each of these steel cords 8C is arranged at a given inclination angle with respect to the radial direction of the tire 1. Each of the steel cords 8C has a cord diameter R within a range of 1.00-1.50 mm.

[0016]

As shown in Fig. 2, a cut end 8Ce of the steel cord 8C at an end 8e of the bead portion reinforcing layer 8 wound outward of the tire 1 has a flare f. This flare f indicates a longitudinally scattered length f at the turnup end 8Ce when the steel cord 8C is cut by means of a cutting tool as defined in the above JIS G3510. In the invention, a component of a width F (mm) in a direction perpendicular to an axis of the cord 8C is adopted as the flare f. The flare f has a scattering width F corresponding to 1.0-1.5 times the cord diameter R.

[0017]

Moreover, many steel cords 8C in the bead portion reinforcing layer 8 are arranged in such a manner that a distance D in a direction perpendicular to the axis of the cord 8C between the cords 8C located inward from the turnup end 8Ce in the radial direction is within a range of 1.00-1.50 mm. Preferably, the cord distance D is equal to the cord diameter R. And also, a coating rubber is filled in the cord distance D.

[0018]

The tire 1 having the above structure develops the following effects (1)-(4):

(1) Since the wind contact part 6w of the carcass 6 has a terminal end, strain applied to the terminal end becomes very small and there is no fear of causing cracks at this terminal end.

[0019]

(2) The diameter R of the steel cord 8C is within a range of 1.00-1.50 mm and the cord distance D is within a range of 1.00-1.50 mm, so that the sufficient bead portion reinforcing effect can be obtained without causing problems in the production. Even if crack is created at the turnup end 8Ce of the steel cord 8C, the crack hardly connects between the adjoining turnup ends 8Ce and hence the occurrence of separation failure is prevented.

[0020]

(3) If the crack created at the turnup end 8Ce grows along the axis of the cord 8C, since the steel cords 8C have no wrapping filament serving as a mediation connecting cracks of adjoining cords 8C to each other and are applied to the bead portion reinforcing layer 8, the connection between adjoining cracks is obstructed to control the occurrence of separation failure.

[0021]

(4) Since the turnup end 8Ce of the steel cord 8C has a scattering width F corresponding to 1.0-1.5 times the cord diameter R, strain applied to the turnup end 8Ce is dispersed into individual filaments constituting the cord in the running of the tire under loading to largely control the occurrence of crack at the turnup end 8Ce.

[0022]

The resistance to separation at turnup end 8Ce portion of the bead portion reinforcing layer 8 is considerably improved by the combination of the above items (2)-(4) and hence the excellent durability of the bead portion 4 can be obtained.

[0023]

When the diameter R of the steel cord 8C is less than 1.00 mm, the end count of the cords 8C should be increased for ensuring the strength and rigidity of the bead portion reinforcing layer 8 and the increase of the end count considerably reduces the distance D between the cords 8C and hence the created cracks are apt to be connected to each other to easily bring about the occurrence of separation failure, while when it exceeds 1.50 mm, the bending rigidity of the cord 8C becomes too high and it is difficult to bend the cord in the tire building as shown in Fig. 1.

[0024]

When the cord distance D between the cords 8C is less than 1.00 mm, the cracks are apt to be easily connected to each other as mentioned above, which

easily brings about the occurrence of separation failure, while when it exceeds 1.50 mm, the strength and rigidity of the bead portion reinforcing layer 8 considerably lower and the effect by the bead portion reinforcing layer 8 can not be obtained.

[0025]

And also, the case that the scattering width F is less than 1.0 times the cord diameter R is not actually existent, while when it exceeds 1.5 times, the filaments constituting the cord are scattered in a long region ranging inward form the turnup end in the longitudinal direction of the cord 8C to cause disengagement of the cord 8C and hence troubles are caused at the tire production steps.

[0026]

The steel cord 8C is suitable to have a Z-lay outer-sheath structure. Because, the outer-sheath is a strand layer located on the surface of the cord 8C and if the filaments on this surface layer are an S-lay, strain applied to the cord 8C in the running of the tire 1 under loading turns toward a direction going away from the cord 8C and hence crack growing along the axis of the cord 8C is apt to be easily connected to crack created in the adjoining cord 8C.

[0027]

[Example]

There are provided radial ply tires for truck and bus of Examples 1-5 having a tire size of 315/60R22.5 and a structure as shown in Figs. 1 and 2. In order to confirm the effect of the example tire, there are provided a conventional tire provided with a radial carcass 16 having a turnup portion 16t shown in Fig. 3 and tires of Comparative Examples 1-5 having the structure shown in Fig. 1 but parts outside the adequate ranges. Moreover, symbol shown in Fig. 3 corresponds to a sum of symbol shown in Fig. 1 plus 10, so that parts and members omitting the explanation in Fig. 3 are based on Fig. 1.

[0028]

With respect to steel cords 8C of a bead portion reinforcing layer 8 (18) in these tires, cord diameter R (mm), distance D between cords 8C (mm), ratio F(mm)/R(mm) of scattering width F (mm)/cord diameter R (mm) and lay direction (Z or S) in outer-sheath (Out.Sh.) are shown in Table 1.

[0029]

[Table 1]

Items	Conventional tire	Comparative Example					Example				
		1	2	3	4	5	1	2	3	4	5
Cord diameter R (mm)	0.80	0.80	1.23	1.23	0.80	1.77	1.32	1.41	1.41	1.05	1.05
Distance between cords D (mm)	0.73	0.73	0.88	1.93	1.45	1.45	1.25	1.41	1.15	1.44	1.44
F (mm)/R (mm)	1.05	1.05	1.05	1.71	1.05	1.71	1.33	1.38	1.38	1.20	1.40
Lay direction	S	S	S	S	S	Z	Z	Z	Z	Z	Z
Bead portion durability (index)	100	105	73	tire production is impossible			147	165	151	155	159
Trouble cause	SEP. at turnup end	SEP. at terminal end	SEP. at terminal end				SEP. at terminal end	SEP. at terminal end	SEP. at terminal end	SEP. at terminal end	SEP. at terminal end

[0030]

With respect to these tires, a durability test on a drum under higher internal pressure and load is carried out to evaluate a bead portion durability. In this case, the running distance until the occurrence of trouble in bead portion 4, 14 is measured and evaluated by an index on the basis that the conventional tire is 100, wherein the larger the index value, the better the durability. And also, the cause on the trouble in the bead portion 4, 14 is observed and specified as separation at turnup end 6we, 16te of the radial carcass or separation at terminal end 8e, 18e of the reinforcing layer 8 (18). The former separation is represented by SEP. at turnup end and the latter separation is represented by SEP. at terminal end. These results are also shown in Table 1.

[0031]

As seen from Table 1, all tires of Examples 1-5 are considerably superior in the durability of the bead portion 4 to the conventional tire, while tires of Comparative Examples 3-5 can not actually be produced and can not be subjected to the drum test for the durability and the tires of Comparative examples 1-2 are equal to or less than the conventional tire in the bead portion durability.

[0032]

[Effect of the Invention]

As mentioned above, according to the inventions described in claims 1 and 2, there can be provided pneumatic tires having a considerably improved bead portion durability by combining the winding structure on the bead core by the radial carcass ply with the peculiar bead portion reinforcing layer.

[Brief Description of the Drawings]

[Fig. 1] is a diagrammatically left-half section view of the pneumatic tire according to the invention.

[Fig. 2] is a schematically partial side view of a steel cord reinforcing layer perspectively drawn from a direction of arrow X in Fig. 2.

[Fig. 3] is a diagrammatically left-half section view of the conventional pneumatic tire.

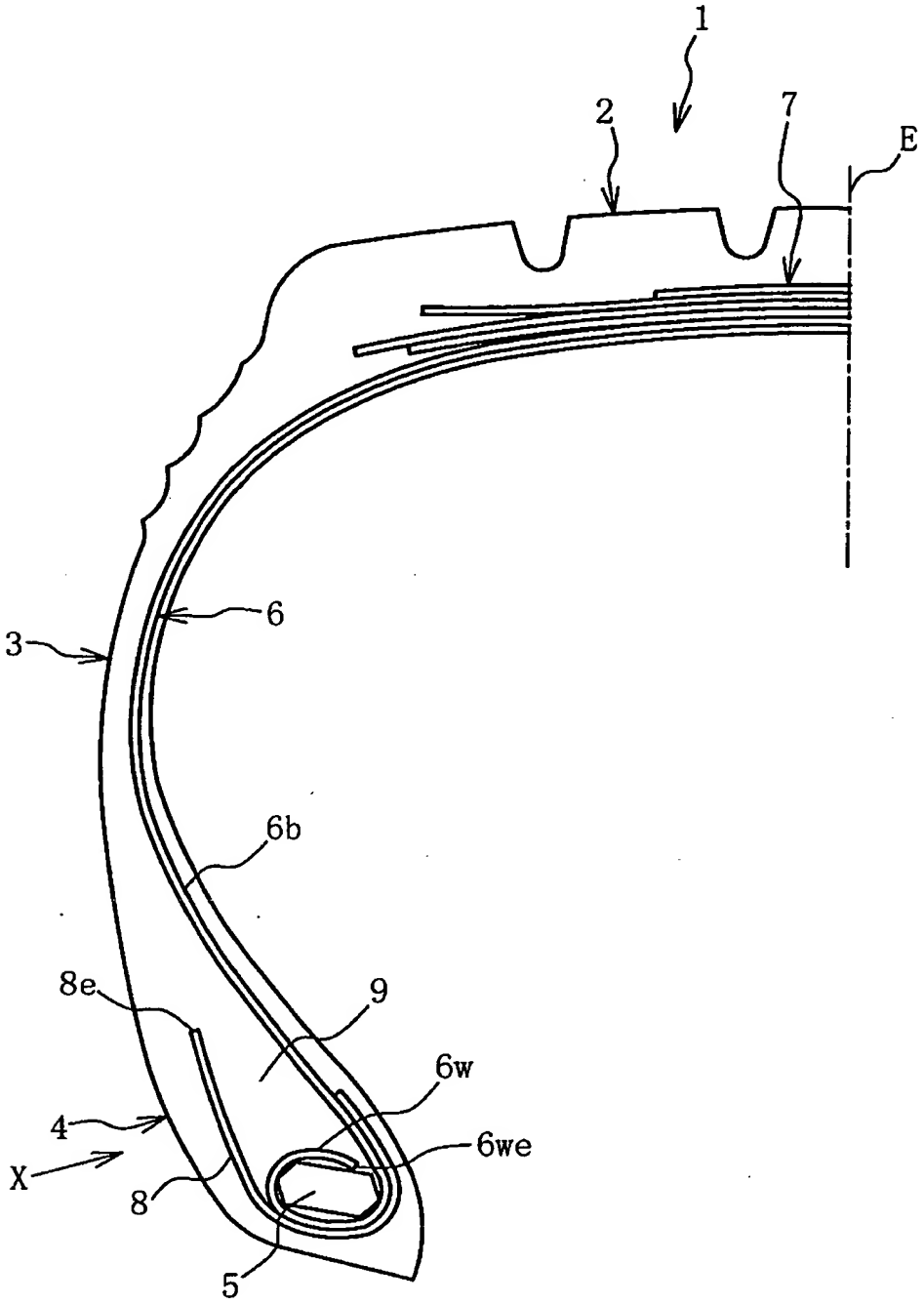
[Description of Reference Symbols]

1 pneumatic tire

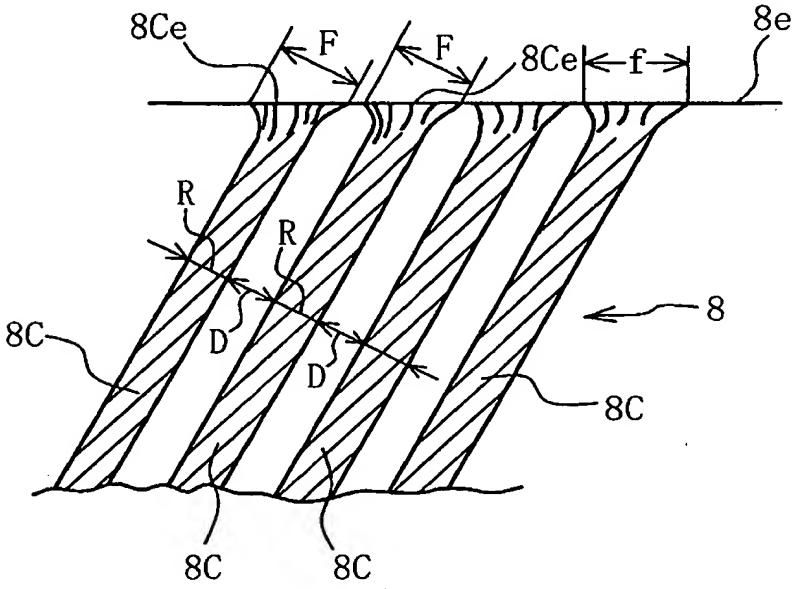
2 tread portion

3	sidewall portion
4	bead portion
5	bead core
6	radial carcass
6b	main body of radial carcass
6w	wind contact part on bead core
6we	terminal end of wind contact part
7	belt
8	bead portion reinforcing layer
8e	terminal end of reinforcing layer
8C	steel cord in reinforcing layer
8Ce	cut end of steel cord
E	equatorial plane of tire
R	cord diameter
D	distance between cords
f	flare
F	scattering width of flare

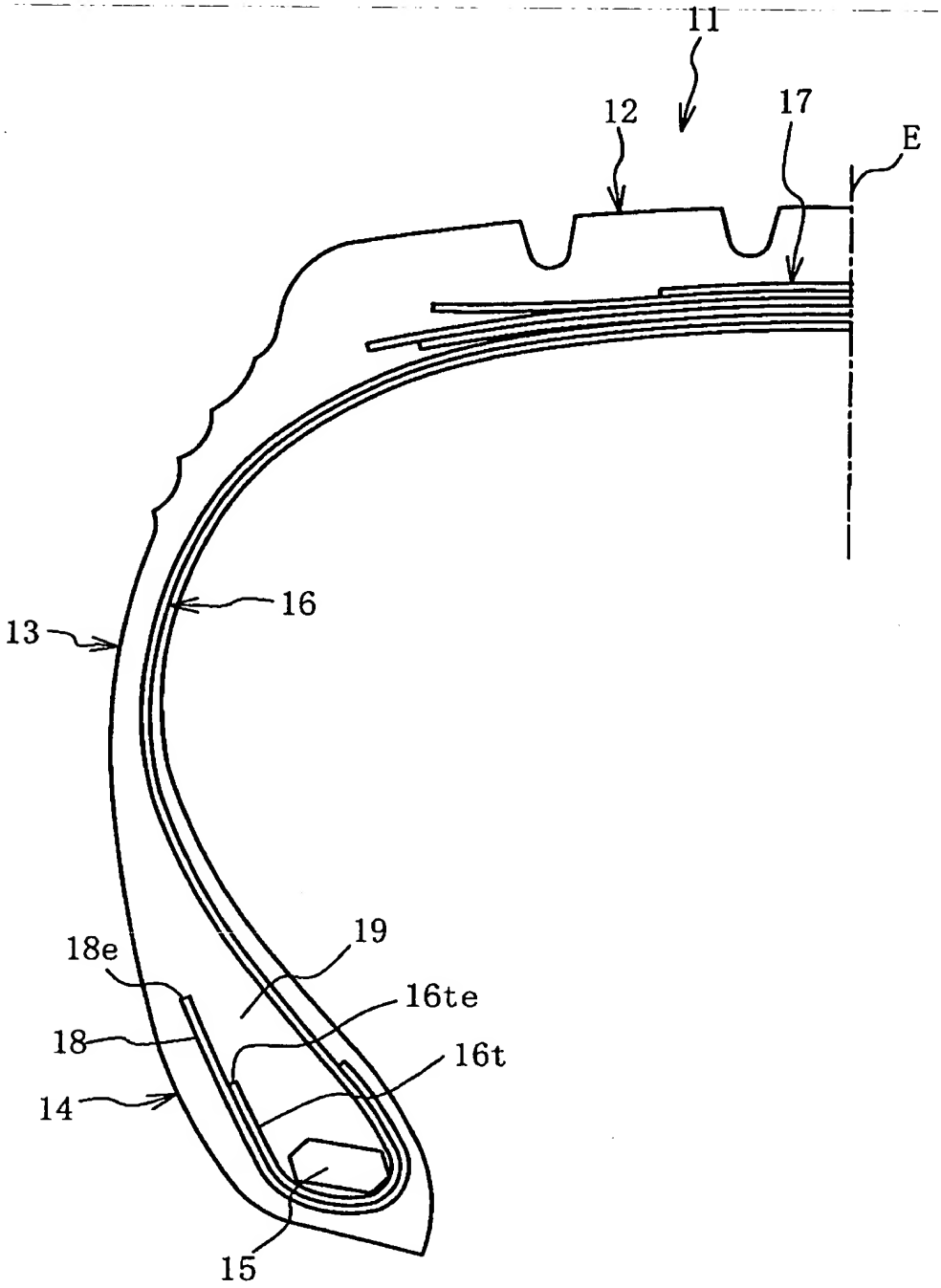
【書類名】　　図面
[Identification of Document]　Drawing
【図１】
[Fig. 1]



【図２】
[Fig. 2]



【図３】
[Fig. 3]



[Identification of Document] ABSTRACT

[Abstract]

[Object] It is to provide a pneumatic tire having a largely improved bead portion durability.

[Means for solution] A radial carcass of one ply has a wind contact part having a terminal end at an outer periphery position of a bead core, and a bead portion reinforcing layer has many steel cords of only a strand structure, and the steel cord has a cord diameter of 1.00-1.50 mm, and the end of the steel cord in terminal end portion of the bead portion reinforcing layer has a scattering width corresponding to 1.0-1.5 of the cord diameter, and the steel cords in the bead portion reinforcing layer are arranged at a distance between the cords of 1.00-1.50 mm in a direction perpendicular to a longitudinal axis of the cord.

[Selected Figure] Fig. 2